

Kindergarten Impacts of a Preschool Language-Focused Intervention

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Many preschool language-focused interventions attempt to boost language and literacy skills in young children at risk in these areas of development, though the long-term effects of such interventions are not well-established. This study investigated kindergarten language and reading skills, specifically the subcomponents of vocabulary, decoding, and reading comprehension, for children exposed to the language-focused intervention *Learning Language and Loving It* (LLLI; Weitzman & Greenberg, 2002) during preschool. End of kindergarten skills were examined, comparing children whose teachers implemented LLLI ($n = 25$) or business-as-usual (BAU) instruction ($n = 24$). Hierarchical linear modeling results showed the LLLI intervention to have significant effects on children's decoding and reading comprehension in kindergarten for children who had high levels of language skill at preschool, as compared to their counterparts in the BAU condition. Study findings therefore indicate that preschool language-focused interventions may primarily benefit children with higher skill levels. This suggests the need to explore avenues for addressing the needs of children with relatively low language skills during preschool and the eventual transition to reading.

Young children from low socio-economic status (SES) backgrounds often show a gap in their language skills relative to children from more advantaged backgrounds (Cabell et al., 2011; Hoff, 2003), which can put them on a language trajectory that is behind their middle SES peers (Hoff, 2013). One reason for this early achievement gap may be inadequate exposure to linguistically rich conversations experienced by these children, as suggested by studies examining the nature of parent-child conversations (Hart & Risley, 1992; Hoff, 2003) or teacher language input (Dickinson & Porche, 2011; Huttenlocher, Vasilyeva, Cymerman, & Levine, 2002). For example, Dickinson and Porche found associations between teacher-child language interactions in preschool and reading, vocabulary, and decoding abilities in Grade 4. Such language input and conversations between children and adults are important to children's language development, as they help them to form

deepened connections between words and meaning, to acquire unfamiliar words as well as new ways to use familiar words, and to develop important conversational skills such as turn taking (Dickinson & Tabors, 2001). Children who lack these experiences are vulnerable to experiencing lags in early language acquisition, which in turn can elevate children's risks for future reading difficulty given the integrative linkages between early language skill and future reading achievement (Dickinson & Tabors, 2001; Storch & Whitehurst, 2002; Whitehurst & Lonigan, 1998).

In this article, we distinguish between language skills (comprised of vocabulary, grammar, and morphology) and literacy skills (comprised of phonological awareness, decoding, and reading comprehension). Specifically, we focus on a subcomponent of language, vocabulary, and two subcomponents of literacy, namely decoding and reading comprehension. All three subcomponents are important and inter-related features of skilled reading. For example, Storch and Whitehurst (2002) found that vocabulary skills in prekindergarten and kindergarten impact later oral language skills, and that decoding in kindergarten predicted Grade 2 reading

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comprehension. Moreover, Whitehurst and Lonigan (1998) found that vocabulary, decoding, and comprehension skills in kindergarten predicted Grade 2 reading comprehension. Additionally, language and decoding skills at 4.5 years have direct and indirect impacts on Grade 3 reading comprehension (NICHD Early Child Care Research Network, 2005).

Although there are many contexts influential to children's language development (Whitehurst & Lonigan, 1998), for this study we focus on the impact that teachers have on aspects of children's language and literacy skills. In the present study, we describe results of a language-focused intervention designed to improve the early language skills (i.e., expressive vocabulary, word structure, and sentence structure) of children from low-SES backgrounds within preschool settings. The principal aim was to determine effects 1-year post-intervention, when children were in kindergarten. Such work is important for considering whether early interventions can promote future reading skills for children from high-risk backgrounds. We investigate the impact that increased vocabulary in preschool may have on vocabulary, decoding, and reading comprehension in kindergarten.

Early Language Interventions

Preschool represents an important early environment in which the language skills of children from low-SES backgrounds, traditionally considered at risk for future language learning difficulties, can be stimulated to improve their language development trajectory (Heckman, 2006; Hoff, 2013). In fact, the rates of return on investment in disadvantaged children is higher the earlier the intervention starts (Heckman, 2006). Moreover, the process of acquiring the ability to read is a developmental continuum where language and literacy skills grow simultaneously and build on each other (Whitehurst & Lonigan, 1998). This suggests that providing a boost in crucial language and literacy skills early in childhood could alter the language trajectory of children. However, typical preschool instruction often does not close the gap between children who have lower and higher levels of language skills at the start of the year (Cabell, Justice, Logan, & Konold, 2013; Greenwood et al., 2013). There is consequently great interest in identifying language-focused programs and practices that preschool teachers may utilize to improve the language skills of children in their classrooms, particularly those with lags in this area of development. Interventions focused specifically on improving children's oral language skills should be distinguished from those focused on improving children's literacy skills (e.g., print awareness, phonological awareness) or language and literacy skills together. Programs focused

specifically on fostering children's language skills seek to improve vocabulary, grammar, and related areas (e.g., narrative comprehension) as important skills in their own right, but also for their contribution to children's future reading skills. The well-established longitudinal relations between early language skills and future reading ability suggests, at least theoretically, that efforts to improve preschoolers' language skills may result in improved word recognition and reading comprehension longitudinally (Catts, Fey, Zhang, & Tomblin, 2001; Fewell & Deutscher, 2004; Mills & Jackson, 1990; NICHD Early Child Care Research Network, 2005; Storch & Whitehurst, 2002).

Language-focused interventions as employed by preschool teachers typically seek to enhance children's language skills by increasing their opportunities to participate in linguistically rich conversations in which teachers may model advanced linguistic forms and labels (Cabell et al., 2011; Coulter & Gallagher, 2001; Girolametto, Weitzman, & Greenberg, 2003; Justice, Mashburn, Pence, & Wiggins, 2008). For instance, one language curriculum developed for preschool teachers to employ in their classrooms features teacher use of seven specific techniques designed to increase children's participation in multi-turn conversations across the day (see Pence, Justice, & Wiggins, 2008). When teachers use this and similarly focused programs, increases in immediate measures of children's language skills (i.e., impacts found immediately to 3 months post-intervention) are often observed, such as children's grammatical complexity during small-group conversations (e.g., Fey, Warren, Fairchild, Sokol, & Yoder, 2006; Girolametto et al., 2003; McIntosh, Crosbie, Holm, Dodd, & Thomas, 2007; Piasta et al., 2012); it is also the case, however, that we seldom see improvements on more long-term measures of language skill (i.e., impacts between 6 months and 2 years post-intervention), such as standardized assessments (Cabell et al., 2011; Henning, McIntosh, Arnott, & Dodd, 2010). Nonetheless, it may be that short-term improvements on immediate measures of language skill, such as children's use of complex syntax during conversations, contribute to longitudinal improvements in language skill as well as other skills for which language skills are foundational, such as reading (see National Early Literacy Panel, 2008). Thus, language interventions have often been successful at improving language skills in the short term, but less is known about the long-term impacts on language and literacy skills.

Long Term Impacts of Language Interventions

To date, we have very little evidence regarding the potential longer-term outcomes of language interventions delivered to preschool children, including those from

low-SES backgrounds, as the majority of studies have looked only at children's language growth during their exposure to the intervention (Baillet, Repper, Murphy, Piasta, & Zettler-Greeley, 2013; Cabell et al., 2011; Girolametto et al., 2003; Jordan, Snow, & Porche, 2000; Justice, Mashburn, et al., 2008; Lonigan, Purpura, Wilson, Walker, & Clancy-Menchetti, 2013). One exception is research involving implementation of dialogic book reading, in which 3-year-old children from low-SES backgrounds participated in linguistically rich conversations during book reading (Whitehurst et al., 1994). Children were assigned to either dialogic reading in the classroom, dialogic reading in the classroom and at home, or an activity control condition. After 6 weeks of participation, children in the intervention conditions had improved expressive vocabulary skills compared to children in the control condition. Longitudinal outcomes were examined 6 months post-intervention, which showed that the intervention effects persisted. Such work suggests that language-focused interventions can yield longitudinal improvements in language skill, at least for a relatively short post-intervention duration and for somewhat young children.

Other work featuring longitudinal analysis of the effects of language-focused intervention delivered to slightly older children (i.e., 3–5 years of age) have reported more mixed results. The report of the Preschool Curriculum Evaluation Research Consortium (2008) included kindergarten outcomes for children from low-SES backgrounds who were exposed to a several different language-focused interventions during the preceding preschool year, such as the *Language-Focused Curriculum* (Bunce, 1995). This curriculum promotes teachers' use of language-facilitating techniques (e.g., recasts, open-ended questions) and activities (e.g., read-alouds, creative play) across the school day that are designed to stimulate children's language skills. In comparison to children in a control group, there was no longitudinal benefit of curriculum exposure based on standardized measures of language skill collected during kindergarten. Similarly, Henning and colleagues (2010) presented 2-year post-intervention results from a study involving children from low-SES backgrounds who participated in a year-long language-focused intervention during preschool (McIntosh et al., 2007). The intervention focused on phonological awareness and language activities including recalling story events, re-enacting a story, isolating sounds from words, and discussing similarities and differences between objects. In the original report of the intervention, study findings showed a positive effect of the intervention on children's phonological awareness and language skills at 3 months post-intervention compared to a control group. However, no positive intervention effects were seen 2 years

later in examining longitudinal effects on language and reading skills (Henning et al., 2010).

Present Study

The present study contributes to the small and mixed literature regarding the potential longitudinal benefits of language-focused preschool interventions for children from low-SES backgrounds. We implemented an intervention with preschool participants, described in Cabell et al. (2011) and Piasta et al. (2012) and followed up with an evaluation of their vocabulary and pre-literacy skills in kindergarten children. These two prior studies present the results of a randomized controlled trial (RCT) involving 49 classrooms that targeted enrollment to children from low-SES backgrounds; the teachers in 25 classrooms were randomly assigned to implement the language-focused preschool program *Learning Language and Loving It* (LLLI; Weitzman & Greenberg, 2002), whereas the remaining 24 teachers employed their business-as-usual (BAU) instructional practices. The LLLI program provides professional development (PD) via workshops, manuals, and modest coaching designed to promote teachers' use of specific strategies to facilitate children's participation in linguistically rich conversations (e.g., encouraging children to take turns, repeating what children say, and asking open-ended questions). Results of the RCT showed that participation in the LLLI PD increased teachers' use of conversationally responsive strategies in the classroom and the lexical and syntactic complexity of children's talk during small-group interactions (Piasta et al., 2012). The findings converge well with results of prior studies involving smaller samples of teachers and day-care providers, suggesting that this program is effective for improving teachers' use of some (but not all) of the targeted strategies as well as some aspects of children's language skills based on observational sources (Girolametto et al., 2003; Girolametto, Weitzman, & Greenberg, 2006). However, these studies did not include standardized measures of children's language skills, nor did they include longitudinal examination of intervention impacts, both of which were included in the more recent evaluation of LLLI (Cabell et al., 2011; Piasta et al., 2012) and the latter of which are the focus of the research reported here.

Regarding the former, impacts of LLLI on standardized measures of children's language skills were presented in Cabell et al. (2011), which examined changes on measures of language subcomponents: grammar and vocabulary and literacy subcomponents: print-concept knowledge and alphabet knowledge for 330 preschool-aged children based on fall and spring assessments during the year of intervention exposure. A significant, positive effect was found, such that

children who participated in the language-focused program had improved skills as demonstrated by their scores on a print-concept knowledge task. Effects on language skills were less straightforward, however, in that the intervention impacts seemed conditional on children's vocabulary ability at the start of the intervention, in the fall of preschool. Specifically, children who had relatively high levels of vocabulary skill and who received LLLI made greater gains in expressive vocabulary over the intervention period relative to similarly skilled children who were in BAU classrooms. Because the primary mechanism of the intervention is children's engagement in linguistically rich conversations with their teachers, the authors speculated that children with higher expressive vocabulary skills are those most able to profit from this approach to improving children's language skills. These results are consistent with other work suggesting that children with higher language abilities benefit from language-focused interventions more so than children with lower language abilities (Blewitt, Rump, Shealy, & Cook, 2009; Penno, Wilkinson, & Moore, 2002), which is interpreted as a Matthew Effect. A Matthew Effect exists when an intervention has positive impacts on higher skilled children relative to less skilled children, such that the "rich get richer and the poor get poorer" (Penno et al., 2002).

The purpose of the present study is to examine 1-year post-intervention, when children are in kindergarten, the impacts of LLLI for children exposed to this intervention during preschool as compared to children who received BAU. Early estimates of the impacts of this intervention during the preschool year suggest the importance of exploring the potential longitudinal impacts of the LLLI intervention for two primary reasons. First, analysis of LLLI impacts on children's skills during preschool showed a complicated pattern of results. Significant, positive effects of the intervention were observed on proximal measures of language skill collected during child-teacher small-group interactions, such that children in LLLI classrooms produced more lexically and syntactically complex talk than children in BAU settings. Positive effects were also observed on a standardized assessment of a literacy skill (i.e., print awareness), though this was not the case for standardized assessments of language skills (i.e., grammar and vocabulary). To wholly reconcile these results, longitudinal analysis of children's performance in kindergarten on measures of the subcomponents of language and reading skills will help us to understand whether these early improvements on some but not all measures might contribute to sustained benefits of the LLLI intervention.

Second, the analysis of LLLI impacts on children's skills during preschool suggested that the intervention may only be beneficial to a subset of children, namely

those who have relatively well-developed vocabulary skills at the onset of the intervention, consistent with a Matthew Effect. This phenomenon has been observed previously within the language-intervention literature, as noted earlier. For instance, Penno et al. (2002) found that preschoolers with relatively high levels of vocabulary skill gained significantly more than preschoolers with low levels of vocabulary skill in a vocabulary-focused program. They interpreted their finding as showing that early language interventions may be insufficient for closing the language gap that distinguishes higher- and lower-skilled children, as it primarily served to benefit those children for whom it was least needed. Longitudinal analysis of children's language and reading skills 1-year post-intervention will help us to understand whether, paradoxically, those with the highest level of language skill during preschool benefited the most from exposure to the LLLI intervention.

Research questions were twofold: (a) to what extent do kindergarten children exposed to LLLI in preschool have better vocabulary, decoding, and passage comprehension skills relative to children exposed to typical preschool instruction; and (b) to what extent do children's broad language skills at the beginning of preschool moderate the longitudinal impacts of the intervention?

METHOD

Research Design and Study Description

This study involved analysis of data collected as part of an RCT designed to assess the efficacy of teacher implementation of a classroom-based language intervention program based on *Learning Language and Loving It* (LLLI; Weitzman & Greenberg, 2002). Impacts observed with respect to changes in teachers' practices and children's short-term gains have been described previously in two reports (Cabell et al., 2011; Piasta et al., 2012). The present work examines 1-year post-intervention impacts for children in vocabulary, decoding, and passage comprehension skills.

LLLI involves teacher implementation of a core set of language-facilitating strategies within their individual- and group-based interactions with children across the day; these include, for instance, asking children a variety of questions, engaging children in extended conversations featuring multiple turns, and expanding and extending children's verbal utterances (Girolametto & Weitzman, 2002). Teachers learn these strategies through professional development workshops based on commercially available materials. To assess impacts of LLLI on both teacher practices and child outcomes, 25 teachers were randomly assigned to implement LLLI in their classrooms over an academic year, whereas 24

teachers were randomly assigned to maintain their prevailing instructional practices. A subset of five to eight children from each classroom was randomly selected to participate in developmental assessments in the fall and spring of the academic year (the exact number differed as a function of the number of caregiver consents received) and 1-year post-intervention. Full details of the main RCT can be found in Cabell et al. (2011).

Participants

All of the participating classrooms targeted enrollment to children from low-SES English-speaking households, to include both Head Start and state-supported preschool programs. From among the 49 classrooms, a randomly selected subset of children ($n = 330$) was identified for ongoing assessments of language and literacy skills that spanned the intervention year (fall and spring of preschool) and 1-year post-intervention. Power analyses were conducted *a priori* to identify the numbers of teachers and children needed to test the primary aims of the study. The random selection of children involved soliciting caregiver consent for all children who met an age-eligibility criterion (3 years, 4 months, in October of the preschool year). From among those children for whom consent was provided, between five and eight children per classroom were selected to enroll in study procedures; the exact number per classroom varied based on how many consents were received.

In the fall of the year during which the RCT was conducted, the mean age of the participating children was 52 months ($SD = 5.5$ months). The study was conducted in a region that was largely rural and not very diverse. The children were diverse with respect to race/ethnicity: 45% were Caucasian, 38% were African-American, and 13% were other race/ethnicities (race/ethnicity was not reported for 4% of children). English was the most common language spoken at home (82%, data were missing for 12%). Only 40% of mothers had education beyond high school. Children were excluded from the study if they were not conversant in English (i.e., their teacher reported that they could not understand the assessment).

In the present study, participants were a subset ($n = 247$) of children in the main RCT, corresponding to about 75% of the original participants. Any children who were missing data on all three outcome measures of interest in this study were excluded, leaving 247 children (129 males, 118 females) whose preschool teachers, in the previous year, had been randomly assigned to one of two study conditions: LLLI implementation ($n = 25$) or BAU ($n = 24$). The majority of children who were missing all three measures at kindergarten, and thus are not included in this follow-up investigation, could not be assessed because they could not be located at

TABLE 1
Differences Between the Retained and Attrited Sample on Preschool Language Assessments

| Language Composite | Retained Sample | | | Attrited Sample | | | Difference | |
|--------------------|-----------------|-------|------|-----------------|-------|------|------------|---------|
| | n | M | SD | n | M | SD | t-value | p-value |
| Pretest | 207 | -0.05 | 0.88 | 64 | -0.48 | 0.88 | -3.35 | .001 |
| Posttest | 218 | 0.55 | 0.93 | 44 | 0.23 | 1.01 | -2.03 | .043 |

kindergarten, potentially because they had stayed for an additional year of preschool. The children who attrited from the study were significantly younger than those retained to follow-up, $t(328) = 3.10$, $p = .002$ and also had lower levels of language skill during the preschool year, as shown in Table 1. It is important to note, however, that attrition did not significantly vary by treatment condition ($\chi^2(1) = 2.51$, $p = .11$). That is, the number of children lost per condition did not differ.

Procedure

During children's preschool year, their teachers were randomly assigned to one of two intervention conditions: implementation of LLLI, which served as the experimental condition ($n = 25$), or BAU ($n = 24$). Irrespective of condition, teachers completed professional development (PD) prior to the start of the academic year as well as a winter refresher workshop. Professional development for the BAU teachers was based on neutral topics to equate contact with the study team. All teachers were provided a video camera and recording media to videotape their classroom instruction every 2 weeks and mail these to the study staff; these videos were coded to examine adherence to LLLI for the intervention teachers and to examine differences in language-facilitating techniques across the two conditions.

Professional development for the teachers in the LLLI intervention was concentrated on improving their use of language-facilitating strategies across the day when interacting with children one-on-one, in small groups, and during whole-class instruction (see Girolametto & Weitzman, 2002). These strategies included, for instance, asking open-ended questions, following children's conversational lead, modeling advanced language forms, and recasting children's utterances. To facilitate teachers' "uptake" of these techniques, they received a user-friendly manual that describes each technique with vignettes, they watched videos demonstrating authentic implementations, and they received feedback letters based on observations of their submitted videotapes that discussed use (or lack of use) of specific strategies. Data presented elsewhere (Piasta et al., 2012) showed that the LLLI teachers improved their use of some but not all of the targeted

strategies, similar to what has been described previously in smaller-scale efforts (Girolametto et al., 2003).

All children in the participating classrooms, both experimental and control, maintained use of their normal educational curriculum (which for 43 of 49 teachers was Creative Curriculum for Preschool; Dodge, Colker, Heroman, & Bickart, 2002). Thus, the primary distinction between conditions is that children whose teachers were in the LLLI condition were exposed to teachers' use of the language-facilitating techniques as an additional component to such instruction.

Intervention Fidelity

Twenty minute videotaped teaching sessions were recorded every 2 weeks between October and April of the academic year to monitor teachers' use of the intervention strategies. The submitted videos were analyzed for fidelity to the intervention. Three videos from each teacher were assessed for fidelity using an adaptation of a tool from the Hanen Centre, which acted as a proximal measure of fidelity to the intervention. Researchers were trained to code the videos and were required to reach 90% accuracy on master coded videos before starting fidelity coding. Additionally, teachers received written feedback on these videos throughout the intervention year. Overall, intervention teachers employed communication facilitating responsivity strategies at a greater rate across the year than those in control centers. Other differences between teachers in the control and treatment conditions were small or nonsignificant. Fidelity to the intervention has been extensively examined in two previous papers (see Cabell et al., 2011 and Piasta et al., 2011).

Measures

A randomly selected subset of children was administered a battery of assessments at three time-points: fall and the spring of the preschool year during which time teachers were in the LLLI or control conditions and 1-year post-intervention, when children were enrolled in kindergarten. The assessments were implemented by trained project staff who had successfully completed a multiple-step training protocol (e.g., quizzes, observed practice implementations). All data collected from children went through a systematic series of audits to ensure accuracy. This included field checks by team leads, double-check of the entry of all test data, and data audits for each measure.

Preschool Measures

From among the measures administered to children during the preschool year, those of relevance to the

present study were three subtests of the standardized, norm-referenced assessment, the *Clinical Evaluation of Language Fundamentals Preschool-2* (CELF:P-2; Wiig, Secord, & Semel, 2004): Word Structure, Sentence Structure, and Expressive Vocabulary. The Word Structure subtest examines children's use of morphology, pronouns, tense, and prepositions; the Sentence Structure subtest examines children's ability to comprehend complex sentence structures; and the Expressive Vocabulary subtest examines children's ability to name objects, actions, and people. Test-retest values for these three subtests ranged from .78 to .90, and internal consistency ranged from .78 to .83 (Wiig et al., 2004).

For the purposes of this study, a composite index of children's language scores across the three subtests was created at both the fall and the spring time-points in preschool. The composite score is a global representation of children's language skills. By using the composite score approach, we capture overall language instead of one specific aspect of the construct. In addition, the composite score approach is more parsimonious. In the HLM analyses, in which we use children's preschool language scores as a covariate, it is more parsimonious to use a single global measure of language as a covariate (and by which to explore interactions between treatment and the three kindergarten outcomes) than to include three separate covariates (as well as their interactions with their three kindergarten outcomes). In addition to parsimony, by using a composite we do not sacrifice the degrees of freedom that would be necessary if we were to control for all three skills (i.e., subtests) separately.

Fall composite scores were created using a three-step process. First, the fall means and standard deviations were obtained for each measure included in the composite. Second, z-scores were created for Sentence Structure, Word Structure, and Expressive Vocabulary by subtracting the mean from each student's score and dividing by the standard deviation. For example, the mean of Sentence Structure in the fall was 10.83, and the standard deviation was 4.75 (see Table 2). To calculate each student's fall z-score for Sentence Structure, 10.83 was subtracted from each student's score (creating a mean of zero across all students), and the resulting sum was divided by 4.75 (rescaling the standard deviation to 1.0 across all students). The third step in the process was summing the three newly calculated z-scores (across Sentence Structure, Word Structure, and Expressive Vocabulary).

The spring (end of year) composite scores were calculated using the fall means and standard deviations. By doing so, the spring composite scores represent the change in children's global language from fall to spring in standard deviation units. The spring composite score calculation was done in two steps. First, standardized estimates were calculated for each of the three observed

TABLE 2
Correlations and Descriptive Statistics for Initial Preschool Language Skills and Kindergarten Outcomes

| | | 1 | 2 | 3 | 4 | 5 | 6 |
|------|------------------------------------------|-------|-------------------|-------------------|-------|-------|-------------------|
| 1 | Preschool Fall: Sentence Structure* | 1.00 | 0.58 | 0.63 | 0.47 | 0.26 | 0.21 |
| 2 | Preschool Fall: Word Structure* | 0.58 | 1.00 | 0.68 | 0.47 | 0.21 | 0.18 ^a |
| 3 | Preschool Fall: Expressive Vocabulary* | 0.63 | 0.68 | 1.00 | 0.72 | 0.28 | 0.14 ^a |
| 4 | Kindergarten: Expressive Vocabulary | 0.47 | 0.47 | 0.72 | 1.00 | 0.27 | 0.19 |
| 5 | Kindergarten: Letter-Word Identification | 0.26 | 0.21 | 0.28 | 0.27 | 1.00 | 0.74 |
| 6 | Kindergarten: Passage Comprehension | 0.21 | 0.18 ^a | 0.14 ^a | 0.19 | 0.74 | 1.00 |
| Mean | | 10.83 | 10.00 | 14.94 | 25.84 | 19.65 | 8.03 |
| SD | | 4.75 | 5.01 | 7.79 | 7.16 | 5.72 | 3.61 |
| n | | 216 | 212 | 211 | 243 | 189 | 190 |

Note. All data represented are raw scores.

*For these constructs the raw scores were z-scored and summed to create a composite of pre-test language used in the analyses. All correlations were significant ($p < .01$) unless otherwise marked (^a $p < .06$).

measures in the spring (Sentence Structure, Word Structure, and Expressive Vocabulary) by subtracting each student's spring observed score from the fall mean and dividing by the standard deviation. To use the same example, students' standardized spring scores for Sentence Structure were calculated by subtracting 10.83 (fall mean; Table 2) from each student's spring score, and dividing the resulting sum by 4.75 (fall standard deviation). In the second step, the standardized estimates of Sentence Structure, Word Structure, and Expressive Vocabulary were summed to create the spring composite.

Kindergarten Measures

In the spring of the children's kindergarten year, measures representing subcomponents of children's language and reading skills were administered. For the former, one subtest of the CELF:P-2 (Wiig et al., 2004) that was administered during preschool was administered, namely the Expressive Vocabulary subtest. We chose this measure of language ability because the previously reported success of LLLI post-intervention was found for expressive vocabulary and we wanted to determine if this effect was maintained (Cabell et al., 2011). For the latter, children's reading skills were measured using two subtests of the Woodcock-Johnson III Tests of Achievement (Woodcock, McGrew, & Mather, 2001). This included the Letter-Word Identification (LWID) subtest and the Passage Comprehension (PC) subtest, described as measuring decoding and reading comprehension, respectively. The LWID subtest examines children's ability to identify letters and pronounce words correctly. The test is untimed, and letters and words were presented with increasing difficulty. The items on the PC subtest are also presented with increasing difficulty, and ask children to select a picture that matches a word or phrase and later to identify what word is missing from a passage. The raw score on both the

LWID and PC subtests is calculated as the total number correct before a ceiling is reached. Unlike the language composite index that was used for end of preschool assessment, the LWID and PC subtests of the WJ were first given to the students in this longitudinal study at the end of kindergarten, and therefore similar composites cannot be created. Raw score means are reported in descriptives tables, but the three outcomes were standardized to a mean of zero and standard deviation of one for use in all predictive analyses.

Analysis

The purpose of this study was to determine whether and to what extent there may be long-term impacts of a language-focused intervention to which children were exposed during preschool on children's language and reading skills 1-year later, and whether children's language skills may serve to moderate the longitudinal impacts of the intervention. To address these purposes, hierarchical linear modeling (HLM) was used to account for the nested data structure, with models fit in SAS proc mixed (SAS v.9.3), nesting students within their preschool teacher's classrooms.

To assess the first research question, we examined differences between the two groups (LLLI, BAU) on three kindergarten outcomes representing language (CELF:P-2 Expressive Vocabulary) and reading (WJ-III LWID and PD) while controlling for children's language skills based on the fall of preschool composite. Three different models were run, one each for expressive vocabulary, decoding (LWID), and reading comprehension (PC). The resulting equation can be represented as:

$$Y_{ij} = B_{00} + B_{10}(\text{Language}_{ij}) + B_{01}(Tx_j) + r_{0i} + e_{ij} \quad (1)$$

where Y_{ij} is the predicted outcome score (expressive vocabulary, decoding, or reading comprehension) for a

TABLE 3
Descriptive Statistics for Kindergarten Outcomes by Condition

| | <i>Treatment</i> | | | <i>Control</i> | | | <i>d</i> |
|------------------------------------------|------------------|----------|-----------|----------------|----------|-----------|----------|
| | <i>n</i> | <i>M</i> | <i>SD</i> | <i>n</i> | <i>M</i> | <i>SD</i> | |
| Kindergarten: Expressive Vocabulary | 131 | 25.91 | 6.94 | 112 | 25.76 | 7.45 | 0.02 |
| Kindergarten: Letter-Word Identification | 105 | 20.14 | 5.63 | 84 | 19.04 | 5.79 | 0.19 |
| Kindergarten: Passage Comprehension | 106 | 8.07 | 3.48 | 84 | 7.98 | 3.79 | 0.02 |

given child (*i*) in a given classroom (*j*). B_{00} represents the intercept or overall mean score on the outcome, B_{10} represents the slope relating the language composite assessed at fall of preschool to the outcome for a given student in a given classroom. B_{01} represents conditional differences in the end of kindergarten score on the outcome between the two groups. Finally, e_{ij} represents error around the prediction due to classrooms, and r_{0i} represents remaining individual residual error.

To assess the second research question regarding moderation via children's language skills, moderation was tested in the HLM models by adding an interaction term between the language composite score (from fall of preschool) and the treatment indicator to the model represented in Equation 1. As with Equation 1, three different models were fitted to the data, each one estimating differences for expressive vocabulary, decoding, and reading comprehension. The final model for these moderation questions can be represented as:

$$Y_{ij} = B_{00} + B_{10}(\text{Language}_{ij}) + B_{01}(Tx_j) + B_{11}(\text{Language} * Tx_j) + r_{0i} + e_{ij} \quad (2)$$

The interpretation of the coefficients is the same as in Equation 1. The new coefficient B_{11} tests the significance of the moderation of treatment differences by children's language skills when predicting the outcome of interest.

RESULTS

The descriptive statistics for the three subtests comprising the initial preschool language composite (Word Structure, Sentence Structure, and Expressive Vocabulary) and the three kindergarten outcome measures (Expressive Vocabulary, Letter-Word Identification, and Passage Comprehension) are presented in Table 2, along with correlations among these constructs. Correlations were particularly strong among the three subtests collected during preschool (all $r > .50$), and between the preschool and kindergarten administration of the Expressive Vocabulary subtest ($r = .72$). Descriptive statistics for the kindergarten outcomes appear in Table 3, as well as effect sizes (Cohen's *d*) representing

the difference between the two groups. Note that the differences between the treatment and control groups are negligible ($d = .02$) or small ($d = .19$) for the three kindergarten subtests, but each favors the treatment group.

The first research question tested the extent to which significant treatment effects were found for measures of children's Expressive Vocabulary, Letter-Word Identification, and Passage Comprehension at the end of kindergarten, ignoring children's initial language skills (Equation 1). In general, the main effects of condition were in the desired direction, such that those children whose teachers had LLLI training during their preschool year had better expressive vocabulary, decoding, and passage comprehension in the spring of kindergarten compared to those children in control classrooms. However, none of the effects were found to be statistically significant ($ps > .20$). Though the results of the analyses corresponding to Equation 1 are not reported, the main effects are reported in Table 4.

The second research question focused on the potential moderating effect of children's language skills, measured in fall of preschool at the start of the intervention, on the long-term impacts of the intervention. Results of these moderator analyses are presented in Table 5. Considering first children's kindergarten

TABLE 4
Kindergarten Language and Literacy Measures

| | <i>Estimate</i> | <i>Error</i> | <i>df</i> | <i>t</i> | <i>p</i> |
|----------------------------|-----------------|--------------|-----------|----------|----------|
| Expressive Vocabulary | | | | | |
| Intercept | 0.03 | 0.08 | 47 | 2.54 | .700 |
| Treatment | 0.16 | 0.11 | 155 | 1.46 | .150 |
| Initial Preschool Language | 0.79 | 0.05 | 155 | 14.89 | <.001 |
| Letter-Word Identification | | | | | |
| Intercept | -0.16 | 0.15 | 45 | -1.10 | .280 |
| Treatment | 0.24 | 1.14 | 113 | 1.22 | .230 |
| Initial Preschool Language | 0.43 | 0.09 | 113 | 5.03 | <.001 |
| Passage Comprehension | | | | | |
| Intercept | -0.05 | 0.12 | 45 | -0.40 | .68 |
| Treatment | 0.09 | 0.17 | 112 | 0.22 | .61 |
| Initial Preschool Language | 0.29 | 0.09 | 112 | 3.22 | .002 |

Note. The intercept represents the mean *z*-score for those children in the control group. The coefficient associated with *Treatment* represents how many *z*-score points higher students in the treatment group are compared to the control group.

TABLE 5
Kindergarten Language and Literacy Scores Moderated by Initial
Preschool Language

| | <i>Estimate</i> | <i>Error</i> | <i>df</i> | <i>t</i> | <i>p</i> |
|----------------------------|-----------------|--------------|-----------|----------|----------|
| Expressive Vocabulary | | | | | |
| Intercept | 0.03 | 0.08 | 47 | 0.39 | .7000 |
| Treatment | 0.17 | 0.11 | 154 | 1.48 | .1400 |
| Initial Preschool Language | 0.76 | 0.08 | 154 | 10.01 | <.0001 |
| Language*Treatment | 0.07 | 0.11 | 154 | 0.61 | .5400 |
| Letter-Word Identification | | | | | |
| Intercept | -0.12 | 0.14 | 45 | -0.83 | .4100 |
| Treatment | 0.20 | 0.19 | 112 | 1.08 | .2800 |
| Initial Preschool Language | 0.23 | 0.13 | 112 | 1.76 | .0800 |
| Language*Treatment | 0.36 | 0.17 | 112 | 2.09 | .0400 |
| Passage Comprehension | | | | | |
| Intercept | 0.07 | 0.16 | 45 | 0.45 | .6600 |
| Treatment | 0.44 | 0.23 | 112 | 1.93 | .0600 |
| Initial Preschool Language | 0.07 | 0.13 | 112 | 0.53 | .6000 |
| Language*Treatment | 0.40 | 0.18 | 112 | 2.20 | .0300 |

Note. The intercept represents the mean *z*-score for those children in the control group. The coefficient associated with *Treatment* represents how many *z*-score points higher students in the treatment group are compared to the control group.

vocabulary skills, initial language skills did not serve to moderate the relations between treatment and the Expressive Vocabulary outcome (Language*Treatment Interaction $B = -0.07$, $p = .54$). However significant moderation was found when examining Letter-Word Identification and Passage Comprehension, which focused on decoding and reading comprehension skills, respectively (Table 5). Specifically, results suggested that treatment effects were conditional on children's level of language skill at the start of intervention: children with relatively high language skills benefitted from LLLI

exposure on both Letter-Word Identification and Passage Comprehension, but this was not the case for children with average or relatively low language skills. In addressing this question, we explored whether the magnitude of change in language skills experienced by a child during the preschool year may have moderated intervention effects. Using a simple difference score (corresponding to the difference between fall and spring language-composite scores during preschool) as a predictor in the model, we determined whether the observed effect held after controlling for the during-intervention change in children's language skills. This difference score was not a significant predictor in any model, and the pattern of significance for the moderated treatment effects discussed in the previous section did not change.

To further explore the significant interactions noted previously, each was probed at three *a-priori* chosen points on the language composite score (based on fall of preschool): the mean and one standard deviation above and one standard deviation below the mean. This test allows for a direct examination of where on the continuum of children's language skills there were significant differences between the treatment and control groups on the outcome. These interactions are graphed in Figure 1 (Letter-Word Identification) and Figure 2 (Passage Comprehension), and both results follow the same pattern: no differences were observed between the treatment and control groups when initial language skills were low (one standard deviation below the mean) or average. However, when students had initially high language skills (one standard deviation above the mean), they were found to significantly benefit from the treatment ($p = .02$ and $.05$ for Letter-Word Identification and Passage Comprehension, respectively).

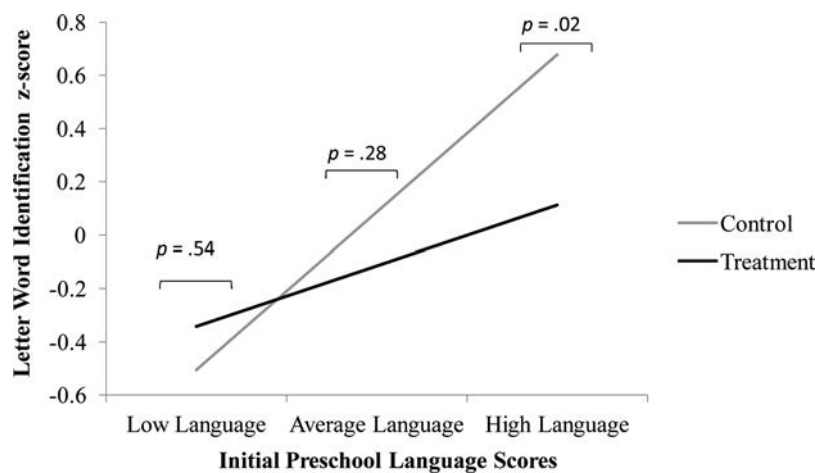


FIGURE 1 Predicted *z*-score letter-word identification subtest of the Woodcock-Johnson (Y-axis) for children with low, average, and high initial preschool language scores (X-axis), presented by treatment condition.

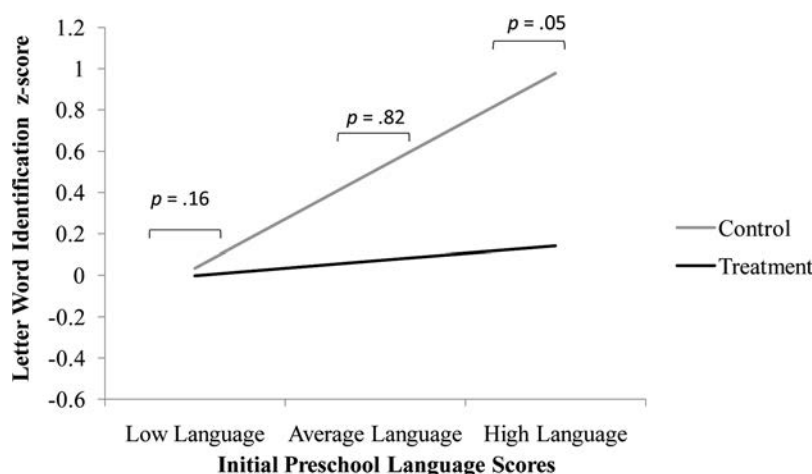


FIGURE 2 Predicted z-scores on the passage comprehension subtest of the Woodcock-Johnson (Y-axis) for children with low, average, and high initial preschool language scores (X-axis), presented by treatment condition.

DISCUSSION

The positive relationship between oral-language skills in preschoolers and later reading abilities (Catts et al., 2001; Fewell & Deutscher, 2004; Mills & Jackson, 1990; NICHD Early Child Care Research Network, 2005; Storch & Whitehurst, 2002) has stimulated researchers to develop and test language-focused interventions that might support children with low levels of language skills (Cabell et al., 2011; Coulter & Gallagher, 2001; Girolametto et al., 2003; Justice, Mashburn, et al., 2008). However, these language interventions primarily test for beneficial effects during or immediately after completion of the intervention (Bailet et al., 2013; Girolametto et al., 2003; Justice, Kaderavek, Fan, Sofka, & Hunt, 2009; Lonigan et al., 2013), with a few exceptions (Henning et al., 2010; Whitehurst et al., 1994). Thus, it is unclear how long-lasting the impacts of language interventions may be, if they are at all.

In the current study, we explored the delayed effects of a language-focused intervention presented to children during a year of preschool. Preschool teachers of participating children either implemented the classroom-based language intervention *Learning Language and Loving It* (LLLI) or maintained typical teaching practices. At 1-year post-intervention, children completed measures of vocabulary and reading (i.e., decoding and reading comprehension). Our results revealed two main findings: (1) there was no long-term impact of the language intervention on children's vocabulary skills, but (2) there was a long-term impact of the intervention on children's decoding and passage comprehension, which was conditional on children's language skills at the start of intervention, consistent with a Matthew Effect. We elaborate on these findings in the following section.

Important Findings

The first main finding is that children experienced no apparent benefit of the language intervention with respect to their expressive vocabulary skills at the end of kindergarten. This was somewhat surprising, given that prior investigations of end-of-preschool effects showed children in intervention classrooms to engage in more lexically-diverse talk compared to children in control classrooms (Piasta et al., 2012) and that improvements in vocabulary skill were observed for a subset of intervention participants (i.e., those within high vocabulary skills at study onset; Cabell et al., 2011). That said, the lack of a long-lasting improvement in vocabulary is consistent with previous studies examining the efficacy of language-focused interventions (Bunce, 1995; Henning et al., 2010). For example, although McIntosh et al. (2007) found improvements in oral language for low-SES children with initially low language abilities (relative to low-SES children with average language abilities) 3 months after an oral language and phonological awareness intervention, these delayed effects were not stable. Specifically, Henning et al. followed up on the language improvements that were found 3 months post-intervention, finding that these language effects did not persist 2 years later and did not transfer to literacy skills, even when accounting for children's initial language abilities. The results of the present work, given alignment with results of other studies of language-focused intervention, suggest that improving young children's language skills, specifically vocabulary, may require more intensive efforts than are currently being trialed. Put differently, improving children's engagement in high-quality conversations across the day may not be sufficient for significantly elevating the vocabulary skills of young children who

already exhibit substantial lags in this area of development. Unfortunately, given that relatively few interventions described in the literature have led to significant improvements in children's skills in this area of development (Cabell et al., 2011; Justice, Mashburn, et al., 2008; Pianta, Mashburn, Downer, Hamre, & Justice, 2008; Powell, Diamond, Burchinal, & Koehler, 2010), it may be that it is time to consider fresh alternatives to the approaches being pursued, at least for children with the most intractable problems with language development.

The latter point is relevant in light of the second main finding in this work, which is that some children did benefit 1-year post-intervention from exposure to this intervention, particularly with respect to skills in decoding and comprehension. Those who did benefit from exposure to the preschool language-focused intervention were those children who had relatively high levels of language skill during preschool. This result is interesting, as it suggests that children who are relatively skilled in this area of development seemed to transfer the skills gained from an intervention focused on oral language to both decoding and reading comprehension skills. Overall, these results are interesting in two important ways.

First, they provide additional support for the view that early language skills are linked to later reading abilities (Catts et al., 2001; Dickinson & Porche, 2011; Fewell & Deutscher, 2004; Mills & Jackson, 1990; NICHD Early Child Care Research Network, 2005; Storch & Whitehurst, 2002), but go beyond previous research by showing a link between a language-focused intervention encouraging children to participate in rich conversations and improved decoding and passage comprehension skills 1 year later. Similar long-term impacts on pre-literacy abilities have been found with shared book reading or dialogic interventions (Dickinson & Smith, 1994; Whitehurst et al., 1994), which encourage children to predict and help tell the story, but we are aware of no work demonstrating cross-transfer effects of early language intervention to future reading skills. For preschool-aged children who have relatively well-developed language skills, it appears that improving their oral-language skills via language-focused intervention can lead to significant improvements in their end-of-kindergarten reading skills.

Second, they provide additional evidence for the Matthew Effect phenomenon within the context of preschool language interventions. Prior work involving delivery of book-reading intervention to children with varying levels of language abilities showed that the intervention was most helpful to children who already had well-developed language skills, specifically vocabulary (Blewitt et al., 2009; Ewers & Brownson, 1999; Penno et al., 2002; Robbins & Ehri, 1994; Sénéchal, Thomas, & Monker, 1995). In the present study, children with low language scores at the

start of preschool did not show improvement in vocabulary, decoding, or passage comprehension skills at the end of kindergarten as a result of the intervention, but their more highly skilled counterparts did. In considering the Matthew Effect as observed in the present study, we note that Stanovich (1986) suggested that increased vocabulary can improve reading abilities, which could then allow for more efficient vocabulary learning, thus creating a reciprocal cycle of language growth. If this was the case for our study, we would have expected children with higher language abilities who received the intervention to show both increased vocabulary and increased reading abilities after the intervention; however, only improvements in decoding and reading comprehension were found. Therefore, our results do not support this reciprocal process. It may be the case, however, that our results reveal only the first step of this reciprocal process, with increased vocabulary resulting in increased reading abilities during an initial interval of observation (preschool to kindergarten). Perhaps if children were observed subsequent to this initial kindergarten time-point, we would begin to see the reciprocal influence of these improved reading skills on vocabulary size, consistent with the Matthew Effect described by Stanovich (1986).

It is important to point out that interventions such as that studied in this investigation are not the only avenues for improving children's language skills. Within the home environment, researchers have studied mothers' elaborative reminiscing as a way to improve children's narrative skills (Reese & Newcombe, 2007). Elaborative reminiscing involves describing a past event with one's child in a manner that involves rich elaboration, such as providing details and asking their children questions while reminiscing (e.g., Do you remember what happened next?). Alternatively, another avenue for improving children's language skills involves engaging them in frequent conversations. Zimmerman et al. (2009) showed that the frequency of multi-turn caregiver-child interactions significantly predicted children's language growth over the preschool years. Consequently, while this study focused on the preschool classroom learning environment, and how teachers' provision of language-focused curricula may support children's language development, there are myriad other ways to do so, in the home and in the school.

Alternative Explanations

In considering the primary results of this study, an alternate perspective to consider is that there may be two types of Matthew Effects characterizing intervention impacts. The first type, a "true" Matthew Effect, may be found when even with equal exposure, children with initially low language skills benefit less than children with higher language skills; this occurs when individual

differences between groups of children influence (or moderate) intervention impacts. The second type may be a result of the teacher, likely unintentionally, differentially implementing an intervention based on the children's language skills. For instance, it may be that a teacher provides less participation opportunities to children with low levels of skill during a language-focused intervention, perhaps because she does not want to frustrate the child.

For example, Penno et al. (2002) reporting finding a "true" Matthew Effect with a book reading intervention designed to teach children new vocabulary words. All children in a class experienced the same intervention, but children with higher levels of language skill learned more new words than children with lower levels of skill. The Matthew Effect here may be caused by children with lower language skills experiencing less teacher interaction than children with higher language skills and thus receive insufficient exposure to the components of the intervention. If this were the case, the Matthew Effect found here could be more reflective of a bias in implementation than a slower learning ability for children with initially low language.

In fact, we have reported elsewhere that the quality of teacher-child relationships is associated with children's language skills: teachers are closer to children with higher levels of language skill (Justice, Cottone, Mashburn, & Rimm-Kaufman, 2008). We can speculate that preschool teachers would differentiate their delivery of these language-facilitating practices as a function of children's language skills, such that children with high levels of language skill might elicit a higher amount of language stimulation from their teachers. Possibly, teachers talk more often with children with whom they feel closer. Additionally, in one-on-one interactions, adult language output tends to be aligned to the language skills of the child, such that children with higher levels of skill tend to evoke (and thus experience) more language from the adults with whom they are interacting (DeThorne & Channell, 2007; Huttenlocher et al., 2002). Teachers who are implementing classroom-based language interventions that involve engaging in high-quality linguistically rich interactions with each child in the classroom may, in fact, be varying implementation as a function of the child's skills with whom they are interacting. If this were the case, it may lead to a type of Matthew Effect, such that the more linguistically skilled children in a classroom would have more teacher interactions, allowing them to benefit more from the intervention implementation as compared to less linguistically skilled children (Stanovich, 1986).

Limitations

This study has several limitations. First, this study examined kindergarten outcomes for a subset of children who had participated in a larger RCT,

corresponding to about 75% of the original sample. The children retained to the follow-up point had better language skills than those not retained, thus it may be that the results would have differed if the entire sample had been included in the follow-up analyses. However, it should be noted that attrition was not differential across the conditions, thus the difference between the two groups of children seen at kindergarten can be interpreted as valid. Second, we do not have sufficient data to determine whether the teachers employed the responsiveness techniques equally to all participating children. If all children did not get equal exposure, the children that the teachers interact with more may be gaining more from the intervention. This is a testable theory that future work on language interventions could explore. A third limitation is the unclear relationship between vocabulary success and improvement in literacy abilities. Despite the previously discussed connection between early language skills and later reading skills, the improvements in early language skills were not maintained. Perhaps the boost in vocabulary at the end of preschool was a result of the teachers talking with and engaging the students more, as prescribed by the LLLI language intervention. As a result of this increased interaction, the number of novel words children typically hear may have increased, allowing the children to expand their vocabulary. However, vocabulary may not continue to grow in the same way if the level of teacher responsiveness is not maintained in the year following the intervention or if vocabulary in kindergarten is taught less explicitly than literacy skills. Interestingly, even without continued growth this initial vocabulary boost may have been enough to give children the foundational skills necessary to advance their decoding and reading comprehension abilities throughout the following year (Storch & Whitehurst, 2002), which we see manifested in larger impacts for those domains at the end of kindergarten.

Conclusions

The results of this study suggest that exploring potential delayed effects of language interventions may reveal previously unrecognized advantages for early literacy skills in the form of decoding and reading comprehension, at least for a subset of children with relatively strong early language skills. To this end, this study has two important implications for future language interventions. First, language focused interventions may show initial, but not lasting improvements in language abilities, specifically vocabulary. Second, the initial language improvement from language interventions may be crucial in developing emergent literacy skills even 1 year after completion of the intervention for children with high initial language abilities. Specifically, the children

who start preschool with higher language skills and experience rich conversations with teachers are likely to progress more on the path to literacy at the end of kindergarten than children with lower initial language abilities. This has implications for the advantages of teacher-child interactions in the classroom, specifically when child-oriented, language-modeling, and interaction-promoting strategies are used. However, a different strategy may be necessary to boost the literacy skills of children who start preschool with lower language skills.

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